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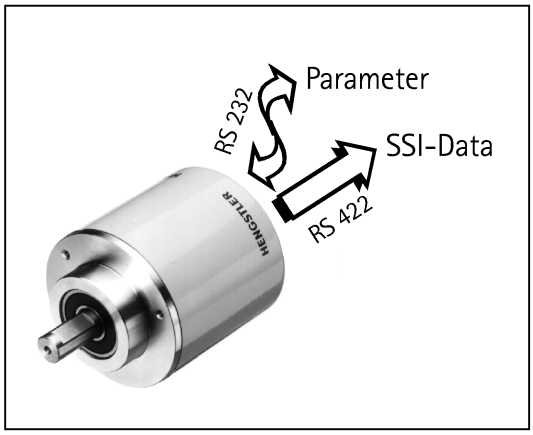

Item no. 2 543 005 Release: 3210799hu

User Manual

Absolute shaft encoder RA 58-P

with SSI programmable

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1 Safety and Operating Instructions

This sign marks paragraphs particularly to be observed to assure proper use and to avoid risks.

- The absolute shaft encoders of the type RA 58-P/RA 59-P model series are quality products manufactured in accordance with established electrical engineering standards.
  The units have been delivered from the factory in perfect conformance to safety regulations.
  To maintain this condition and to ensure trouble-free operation, please ob-serve the technical specifications of this document.
- Installation and mounting may only be performed by an electrotechnical expert!
- The units may only be operated within the limits specified by the technical data.
- Maximum operating voltages must not be exceeded!
  The units are designed complying with DIN EN 61010-part 1, protection class III.
  To prevent dangerous structure-borne currents, the equipment has to be run on safety extra-low voltage (SELV) and must be in an area of equipotential bonding.
  Please use an external fuse for protection (see Electrical Data).
- Fields of application: industrial processes and controls.
  Overvoltage at the connecting terminals must be limited to overvoltage-class-II values.
- Please avoid shocks to the housing – especially to the encoder shaft – and axial or radial overload to the encoder shaft.
- Maximum accuracy and durability of our shaft encoders are only granted when using suitable couplings.
- The high-quality EMC-specifications are only valid together with standard-type cables and plugs. When using screened cables, the screen must broadly be connected with ground on both ends. Likewise, the voltage-supply cables should entirely be screened. If this is not possible you will have to take appropriate filtering measures.
- Installation environment and wiring are influential on the encoder's EMC: Thus the installer must secure EMC of the whole facility (device).
- In electrostaticly threatened areas please take care for neat ESD-protection of plug and connecting cable during installation work.

2 Preface

This manual provides information on the function of the programmable shaft encoder RA 58P and on it´s parameters.

The user documentation for this encoder comprises

- the installation instructions (Item no. 2543007) with informations for connection and initial operation
- this user manual
- the user manual (Item no. 2543006) with a description of the PC programming software

3 Introduction

Absolute angle encoders supply an absolutely encoded value for any possible angular position. All such values are stored in the form of a code pattern on one or several encoder disks. The encoder disks are scannes opto-electronically. The bit patterns obtained in this procedure are amplified and fed to a microprocessor (µP). The processed values can be enquired at the SSI interface.

The absolute angle encoder RA58-P resolves one encoder revolution into 4096 measuring steps (= 12 bits). The number of revolutions is 4096 (= 12 bits). This results in an encoder range of 2^{24} measuring steps.

The result of 12 bits + 12 bits is output together with an additional status byte as a 4 byte value. Data output is optionally possible in binary or Gray code.

The angle encoder RA58-P is available in various mechanical versions (refer to the section "Dimensioned drawings" on page **Fehler! Textmarke nicht definiert.**).

The angle encoder RA58-P can be programmed via RS232 interface. With this function the encoder can be used universally. Thus, a lot of computing time can be saved and additional processing can reduced in the automatic control systems.

For remanent storage of parameters the RA58-P is equipped with an EEPROM. When the device is switched on, parameters are automatically loaded into the working memory.

The RA58-P is programmed by means of a commercial MS-DOS PC via serial interface RS232. For this purpose a PC program including an adaptor cable is available (Item no. 1 543 014). The program is menu controlled and enables conveient entry and transmission of parameters.

3.1 On this manual

In the following the term "number of measuring steps" describes the position determined by the encoder before processing in the "electronic gear". The "actual value" designates the value transmitted to the control system after processing (behind the "electronic gear"). The unit of measure for this actual value is "steps".

For programming the RA58-P, the programming device (PC with programming software) transmits the corresponding configuration parameters (in the following called "CP") to the RA58-P unit.

The data format in which the data are transmitted to the RA58-P is described in the section "Data transmission to RA58-P via RS232" on page 13.

3.2 Abbreviations

The following abbreviations are used in this manual

ccw	=	counter-clockwise
cw	=	clockwise
Dt	=	data transmission
AV	=	actual value
CP	=	configuration parameter
LSB	=	least significant bit/byte
MB	=	middle byte
MF	=	monoflop
MSB	=	most significant bit/byte
S/rev	=	steps per revolution
SCF	=	scaling factor
t_m	=	monoflop period
T_p	=	Clock pause
rev	=	revolution
S	=	sign
xxx	=	undefined
µP	=	microprocessor

4 Non-volatile memory in the RA58-P

The RA58-P includes two different types of data memory:

- A volatile memory (RAM) which is used as a working memory into which the CP are entered after receipt from the programming device. Data stored in the volatile memory are lost when the supply voltage is switched off.
- A non-volatile memory (EEPROM) which retains its data independent of the power supply.

When the CP are transmitted from the programming device to the RA58-P, they are initially entered only into the working memory. After all required CP have been sent and when the encoder supplies the values in conformance with system configurations, the working memory contents can be transferred to the non-volatile memory with the command »Save into EEPROM«.

When switching the power supply on, RA58-P will automatically copy the contents of the non-volatile memory into the working memory, and the encoder then works with the data specified by the control system.

With the command »RAM Default Values« all parameters in the working memory are reset to default values. In this case the encoder will transmit the original encoder steps as actual values to the control system. The originally set parameters can be retrieved with the command »Load from EEPROM «.

The command sequence »RAM Default Values«, »Save into EEPROM« resets the non-volatile memory; consequently the encoder will work with an SCF of "1", a zero shift of "0" and code characteristic "cw".

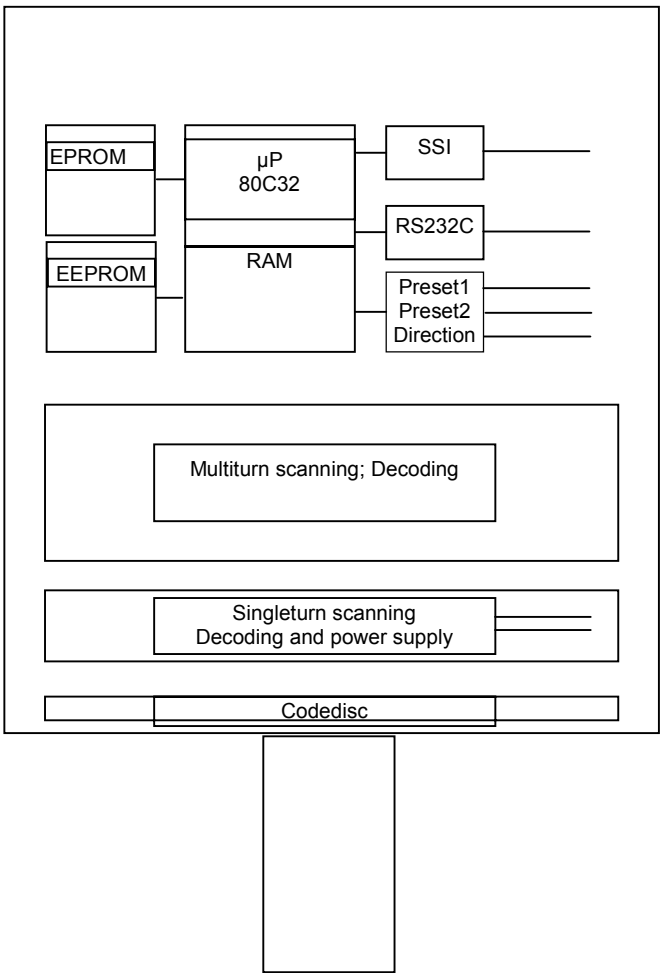


Fig. 1: RA58-P with SSI interface (schematic layout diagram)

4.1 SSI interface

4.1.1 Layout

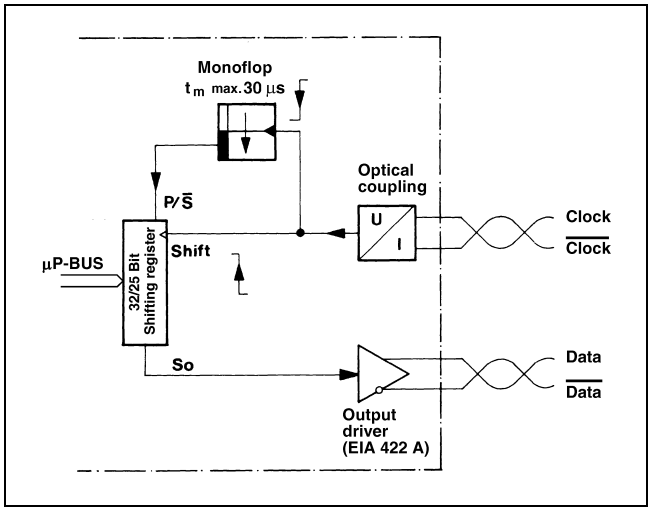


Fig. 2: Block diagram of SSI interface

The shift clock is supplied externally by the control system. Electrical insulation from the RA58-P is provided by an optocoupler. Encoder data and status bits are loaded into a 32-bit shift register by the microprocessor. Data are output synchronously with the external shift clock via an RS422 driver (refer to "SSI clock diagram" on page 11).

4.1.2 Transmission procedure

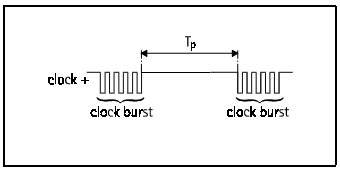


Bild 3: Clock burst

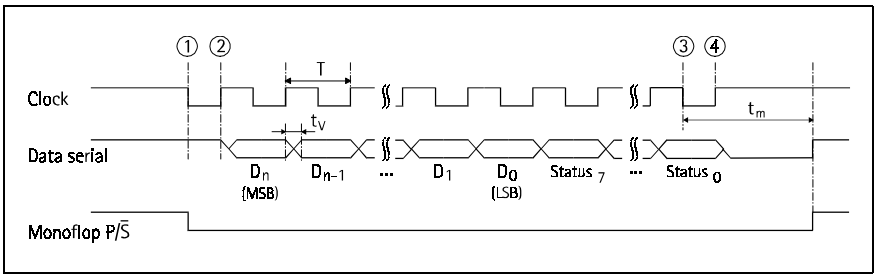


Bild 4: SSI clock diagram

Correct data transmission requires that a defined number of pulses (i.e. a clock burst) is supplied to the shaft encoder input. Then a pause T_p is required.

As soon as a clock burst is present at the clock input, the current angle information is stored. With the first transition of the clock signal from High to Low ① the retriggerable monoflop integrated in the shaft encoder is set; its monoflop period t_m must be longer than the period T of the clock signal.
With each additional falling edge the active status of the monoflop is prolonged by t_m (for the last time at ③).
The monoflop output controls the shift register via connector $P/\overline{S}$.

With the first transition of the clock signal from Low to High ②, the most significant bit (MSB) of the angle information is supplied to the serial data output of the shaft encoder.
With each additional rising edge the next less significant bit will be shifted to the data output.

With a data signal length of 32 bit (single transmission), 7 status bits are output after the transmission of the least significant bit (LSB). The data line then switches to Low until the time t_m has elapsed.
The next data transmission with a new value can only be started when the data line switches back to High ④.

If further clock signals are sent before the monoflop period has elapsed, output will respond as follows:

- Data signal length = 32 bit (single transmission):
  With each additional clock signal a "0" will be output.
- Data signal length = 25 bit (multiple transmission):
  After output of 24 data bits the status bit 7 and a pause zero is output, the the output of the stored information begins from the start.

At the end of a clock burst the data line remains on log. 0 (»busy«) for the duration of the monoflop period.
After the monoflop period has eleapsed, the data line will be set to log. 1 (ready).
When the next clock burst begins, the shift register will again be loaded with the current actual value supplied by the µP.

Technical data of the SSI interface:

Clock frequency:	70 kHz.....1.5 MHz
Monoflop period t_m:	20µs ≤ t_m ≤ 30 µs
Clock burst:	32 clock pulses
Multiple transmission:	n • 26 clock pulses
Delay time t_v:	<100 ns (without cable)
Data refresh:	every 600 µs

4.2 RS232 interface

Function: Transmission of encoder parameters **to** RA58-P.
Reading of stored encoder parameters and encoder actual values **from** RA58-P.

Baud rate (fixed):	2400 Baud.
Byte format:	1 start bit, 8 data bits, no parity, 1 stop bit.
Protocol:	DK3964R (Siemens)
Protocol length:	4 Byte to RA58-P
	4 Byte from RA58-P (without protocol frame)
Signals:	RxD, TxD, signal ground

DK3964R protocol:

PC	STX		CP no.	MSB	MB	LSB	DLE	ETX	BCC	
RA58-P		DLE								ACK
			Useful data → RA58-P							

RA58-P	STX		MSB	MB	LSB	XXX[1)]	DLE	ETX	BCC	
PC		DLE								ACK
			Useful data → PC				[1)] or status byte			

The "transmitter" starts data transmission with "STX". The "receiver" confirms its ready-to-receive state with "DLE". The "transmitter" then begins to transfer the useful data. The end of the protocol is triggered by the transmitter with "DLE". In order to clearly mark the end of the telegram, the useful data byte is transmitted twice if its value is "10H" (="DLE"). Then follow the characters "ETX" and "BCC" (checksum). The "receiver" acknowledges the proper receipt of the telegram with "ACK" (acknowledge). If the telegram has not been received properly, the "receiver" will answer with the character "NAK" (not acknowledged). The transmitter then repeats the entire telegram.

4.3 Data transmission to RA58-P via RS232

In the DK3964 protocol frame 4 bytes of data are transferred to the RA58-P unit. The RA58-P unit will, in return, answer with an equal set of 4 bytes of data if required. In the first byte transmitted the parameter number (CP no.) is encoded. Then the corresponding data bytes follow. These data bytes are stored in the working memory of the RA58-P unit after data transfer is completed. All data entries are made in the hexadecimal number system (H). Data which will not be evaluated are designated with "XXX"

Parameter	CP no.	Data MSB	Data MB	Data LSB

4.4 Variable parameters

4.4.1 Preset

int. Preset	01H	MSB	MB	LSB

The internal preset is an absolute preset value. After transmission of this parameter the actual values change to the set values.

ext._Preset1	02H	MSB	MB	LSB

External Preset1 is an absolute preset value. After transmission of this parameter the corresponding preset values are saved. By supplying a positive voltage pulse >255 ms (debouncing time) to external preset input 1 resp. by pressing the preset button (version RS485+preset button only), the actual values change to the set value (besides the external activated preset value is also stored automatically into EEPROM). External preset 1 can be disabled or enabled (refer to "Switch functions" on page 20).

ext._Preset2	03H	MSB	MB	LSB

External Preset2 is an absolute preset value. After transmission of this parameter the corresponding preset values are saved. By supplying a positive voltage pulse >255 ms (debouncing time) to external preset input 2 the actual values change to the set value (besides the external activated preset value is also stored automatically into EEPROM). External preset 2 can be disabled or enabled (refer to "Switch functions" on page 20).

4.4.2 Offset

Offset	04H	MSB	MB	LSB

The offset value effects a relative shifting of the actual values. After transmission of the offset value the current actual value will be shifted by the amount of the offset value. Presets delete the set offset value.

4.4.3 Resolution

Note: ***A change in the physical encoder resolution by entering a scaling factor only has an effect in the data format »Standard«. In the »Tannenbaum« format, the resolution will always equal 1 regardless of entering a scaling factor or not!***

Encoder resolution can be modified by three different methods:

1. Direct entry of a scaling factor (SCF): CP no. 08H.
2. Entry of the number of revolutions and (required) number of steps: CP no. 09H and 0AH
3. Entry of the number of measuring steps and (required) no. of steps: CP no. 0BH and 0AH

SCALING FACTOR	08H	MSB	MB	LSB

The scaling factor (SCF) is used for modifying the encoder resolution. Actual values are multiplied by the SCF. The SCF is interpreted as a number < 1. It is transmitted as an unsigned 3-byte number. Its maximum value is FF FF FFH (≈ 1 in decimal notation).

If, for example, resolution is to be halved, the SCF must be 80 00 00H (= 0.5 in decimal notation). An SCF of 40 00 00H corresponds to a decimal factor of 0.25, etc.

⇒ Formula for converting the desired decimal SCF (<1) into the corresponding hexadecimal value:

1. multiply the decimal SCF with 2^{24}
2. round this value to a decimal integer number
3. convert the rounded number into a hexadecimal number

Number of revolutions	09H	XXX	MB	LSB

A desired number of steps can be assigned to a certain number of revolutions (measuring distance) (CP no. 0AH). The range of values for the number of revolutions is 1...FFFH. The number of revolutions is an unsigned integer value. After the number of revolutions **and** the required number of steps have been entered, the RA58-P unit will calculate the SCF automatically.

Steps	0AH	MSB	MB	LSB

Entry of required number of steps to be output for a measuring distance. The value range for the number of steps is 0...FF FF FFH.

Number of measuring steps	0BH	MSB	MB	LSB

The required number of steps (CP no. 0AH) can be assigned to a number of measuring steps (measuring distance). The range of values for the number of measuring steps is 1...FF FF FFH. The number of measuring steps is an unsigned integer value. After the number of measuring steps **and** the required number of steps have been entered, the RA58-P unit will calculate the SCF automatically.

4.4.4 Internal encoder functions

Save into EEPROM	1AH	XXX	XXX	XXX

The parameters stored in the working memory (RAM) are saved in the EEPROM for remanent storage. After a reset (when switching on the power supply) the parameters will be loaded into the working memory automatically.

Load from EEPROM	1BH	XXX	XXX	XXX

The parameters held in remanent storage in the EEPROM are reloaded into the working memory.

RAM Default Values	1CH	XXX	XXX	XXX

The working memory is deleted. All parameters are reset to default. (refer to "Parameter default settings" on page 25.)

32/25 bit mode	1DH	XXX	XXX	LSB=0/1

With this function the physical length of the SSI shift register can be switched.

LSB = 0: length= 32 bits
LSB = 1: length= 25 bits

(refer to "Transmission procedure" on page 11

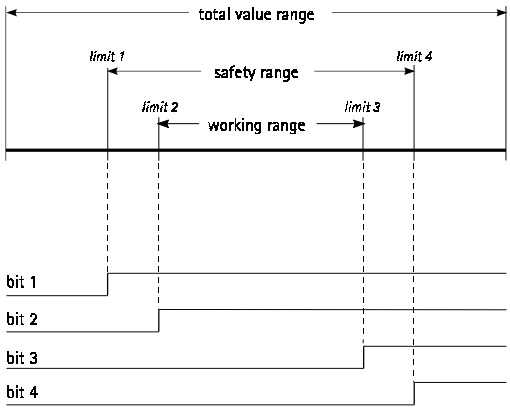
4.4.5 Limit positions

All limit positions (soft limits) are set as 3-byte values. They can be freely adjusted within the value range of the encoder. A marker bit is set when the corresponding limit position has been reached. This bit can be output as a status bit at the SSI interface (refer to "bit positions on page 22).

Limit 1	10H	MSB	MB	LSB
Limit 2	11H	MSB	MB	LSB
Limit 3	12H	MSB	MB	LSB
Limit 4	13H	MSB	MB	LSB

Example of an application of these limit positions:

A savety range (from limit value 1 to limit value 4) and a working range (from limit value 2 to limit value 3) should be defined.



Upon reaching the respective limit values, the related status bit is set and remains set as long as the condition „ current position ≥ limit value" is fulfilled.

A following control can thus evaluate these limit value status bits directly and does not need to compare each position value with the limit values any longer. This reduces the control's workload meaning that it becomes faster and the programming effort is reduced.

Evaluation of the control:
Current position lies within the **safety range** when **bit 1 is set and bit 4 is not set**.
Current position lies within the **working range** when **bit 2 is set and bit 3 is not set**.

4.4.6 SSI output formats

Number of bits, tannenbaum format	14H	XXX	XXX	S/REV	rev
				LSB	

In the "tannenbaum format" (please refer to chapter "Switch functions" on page 21), bit 13 and bit 14 are always located in the same bit position, independent of the selected resolution. The number of significant bits can be set separately for S/rev and rev. The numbers are 0...12 in decimal notation (= 0...CH) for the steps per revolution and 0...12 in decimal notation (= 0...CH) for the number of revolutions. Both values are encoded in the upper/lower tetrade of the LSB.

If the LSB value is, for example, 9BH, 9 bits of steps per revolution (= 512 S/rev) and 11 bits of revolutions (= 2048 rev) are output. Missing bits are filled with zero.

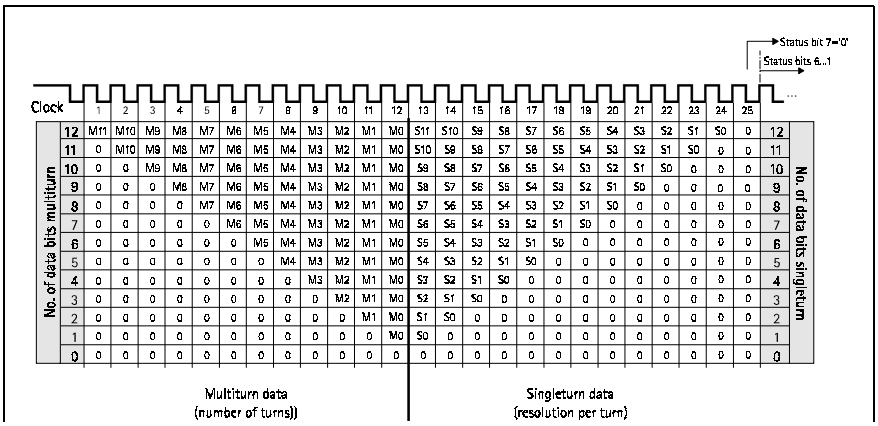
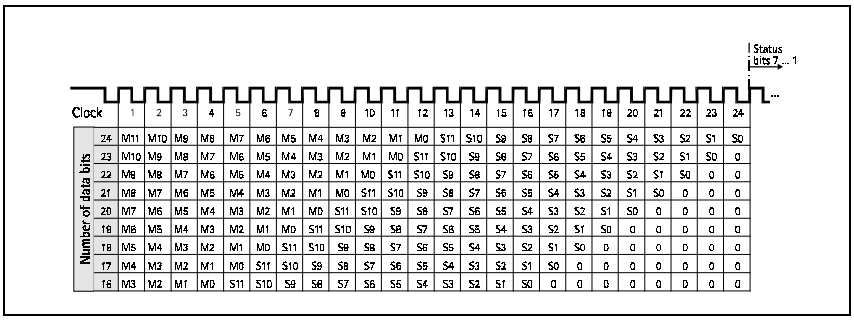


Fig. 5: Data bit arrangement in the tannenbaum format

Note:
1. *The tannenbaum format is designed for an encoder with a resolution of up to 13 bits singleturn data.*
   The Encoder RA58-P however delivers 12 bit single turn data (clock pulse 13...24) and the first status bit with the bit position 7 in clock pulse 25.
   Therefore, the bit position 7 may not be used as a status bit in the tannenbaum format.
2. *In the tannenbaum format the number system must be set to »**integer**«.*

No. of bits in standard format	15H	XXX	XXX	LSB

In the standard format (please refer also to "Switch functions") the number of significant bits can be set between 16...24 decimal (= 10H...18H). The data are shifted by (24 - number) bit positions towards the MSB. The remaining LS-bits are filled up with zero.



Number of data bits	Clock 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
24	M11	M10	M9	M8	M7	M6	M5	M4	M3	M2	M1	M0	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0
23	M10	M9	M8	M7	M6	M5	M4	M3	M2	M1	M0	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0
22	M9	M8	M7	M6	M5	M4	M3	M2	M1	M0	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0
21	M8	M7	M6	M5	M4	M3	M2	M1	M0	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0
20	M7	M6	M5	M4	M3	M2	M1	M0	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0
19	M6	M5	M4	M3	M2	M1	M0	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0
18	M5	M4	M3	M2	M1	M0	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0
17	M4	M3	M2	M1	M0	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0
16	M3	M2	M1	M0	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0

Fig. 5: Data bit arrangement in the standard format.

4.4.7 Special functions

Overspeed	16H	XXX	XXX	LSB

When the set overspeed value is reached, a marker bit is set (please refer also to "Bit positions" on page 22). The input format is "multiples of 100 rpm". The value range for the input is 0...255 in decimal notation (= 0...FFH)

If, for example, the LSB value is 47 in decimal notation (= 2FH), the marker bit will be set at a rotational speed of 4700 rpm. Accuracy of measurement is approx. ± 5%.

4.4.8 Switch functions

Switch functions are used for switching on/off or modifying certain encoder functions (enable/disable). In all cases the LS bit of the last byte is used for the switch function. If the LSB is 1 or 2, the function is switched on. The function is switched off when the LSB is 0.

ext. Preset1 On/Off	20H	XXX	XXX	LSB=1/0

ext. Preset2 On/Off	21H	XXX	XXX	LSB=1/0

ext. switching forw./rev. On/Off	22H	XXX	XXX	LSB=1/0

Gray/binary code switch	23H	XXX	XXX	LSB=1/0

Binary code output: LSB = 0 ; Gray code output: LSB=1

Two's complement/ integer/separate sign	24H	XXX	XXX	LSB=0/1/2

Two's complement notation: LSB = 0
Integer notation: LSB = 1
Separate sign: LSB = 2

Two's complement notation:

-max.value	-3, -2, -1	0	1, 2, 3	+ max.value

In two's complement notation (values signed) the zero point is located in the middle of the value range:
(800000H...FFFFFFH, 0, 000001H...7FFFFFH with SCF=1))

Integer notation:

0.....	max.value

In integer notation (values unsigned) the zero point is located at the beginning of the value range: (000000H...FFFFFFH with SCF=1)

Separate sign:

VZ | +max.value	3, 2, 1	0	1, 2, 3	+ max.value

In the notation with separate sign the zero point is located in the middle of the value range: (FFFFFFH...800001, 0, 000001H...7FFFFFH with SCF=1). The sign is encoded separately in the MSB. In the range below zero the sign is 1, in the range above zero the sign is 0.

Tannenbaum/standard format	25H	XXX	XXX	LSB=0/1

Standard format: LSB = 0
Tannenbaum format: LSB = 1

Standard format: LSB = 0

In the **standard format** the number of significant bits can be set to values between 16...24 in decimal numbers. Data are shifted towards the MSB by 24 minus the number of bit positions (the encoder data are output at the SSI in MSB-justified form) The remaining LS-bits are filled with zeros (See CP no. 15H for description).
The length of the shift register can optionally be set to 32 bits or to 25 bits (CP no.1DH).

Tannenbaum format: LSB = 1

In tannenbaum format bit 12 and bit 13 are always located in the same bit position, independent from the selected resolution setting (see CP no. 14H for description)
The length of the shift register can optionally be set to 32 bits or to 25 bits.

Internal switch forw./rev.	26H	XXX	XXX	LSB=0/1

Counter sense forward: LSB = 0
Counter sense reversed: LSB = 1

When external direction switching function is activated, LSB = 1 will reverse the counter sense selected by the external control.

ext. length measurement (Teach in) On/Off	27H	XXX	XXX	LSB=0/1

External preset inputs are used for starting and stopping length measurements.
Requirement: The external presets 1 and 2 are both set to »On«.
For starting a measurement the external preset 1 is triggered with a positive pulse. The encoder value jumps to the preset value. Preset 1 must then be deactivated again. After pacing off the measuring distance a positive pulse at external preset 2 stops the measurement for the duration of the pulse. During this period the measurement result can be read out.

4.4.9 Bit positions in the status byte

When set limit values such as limit positions, overspeed values or encoder standstill are reached, bit markers will be generated. These markers can be assigned to any position in the status byte.

The bit function is set by means of the CP no. Bit positions are encoded in the LSB.

Bit position 1...7 is encoded in LSB bits 0, 1, 2; bit 3 is a bit switch (On/Off) for the selected function. Bit 4 switches between 1-active/0-active. Bits 5, 6, 7 are not being used.

Please note:Bit position "0" is always log. 0.

Bit no.:	7	6	5	4	3	2	1	0
LSB:	X	X	X	1/0 active	On/Off	B.Pos2	B.Pos1	B.Pos0

Bit positions 1...7 in the status byte can be assigned to the following functions:

Bit position for limit1	28H	XXX	XXX	LSB

Bit = 1 when set limit positions are reached.

Bit position for limit2	29H	XXX	XXX	LSB

Bit position for limit 3	2AH	XXX	XXX	LSB

Bit position for limit 4	2BH	XXX	XXX	LSB

Bit position for overspeed	2CH	XXX	XXX	LSB

Bit = 1 when set overspeed value is reached.

Bit position for encoder standstill.	2DH	XXX	XXX	LSB

Bit = 1 in case of encoder standstill

Bit position for parity	2EH	XXX	XXX	LSB

Bit = 1, when parity of the 3 SSI data bytes and status byte is even

Bit position for encoder error	2FH	XXX	XXX	LSB

Bit = 1 in case of internal encoder error (overtemperature, undervoltage, glass breakage).

Bit position for direction check	30H	XXX	XXX	LSB

Bit = 1 for ccw rotation

4.4.10 Reverse reading of encoder values and set parameters

PC → RA58-P

CP no. 80H is reserved for the "reverse reading" function. In the LSB the CP no. to be read in reverse is set.

Exception: Encoder actual values incl. status byte can be read with CP no. 00H.

Read encoder actual values	80H	XXX	XXX	00H

Read parameters	80H	XXX	XXX	CP no.

RA58-P → PC

The reply message also comprises 4 byte of data.

Transmit encoder actual values	MSB	MB	LSB	Status byte
	current encoder actual values			

Transmit parameters	MSB	MB	LSB	XXX
	set parameter			

5 Transmission sequence

When programming the RA58-P some parameters require that a certain transmission sequence is observed.

5.1 Sequence of parameter entries

1. »RAM Default Values«
2. Encoding characteristic
3. Scaling factor
4. Preset values
5. remaining functions (data formats, status bit functions, etc.)
6. »Save into EEPROM« (remanent data storage).

5.2 Parameter default settings

The RA58-P is preset to the following parameter default values:

1.	Preset:	"0"
2.	Offset:	"0"
3.	Scaling factor:	"1" (encoder resolution 2^{24} steps)
4.	Encoding characteristic:	cw
5.	Binary data output format, two's complement notation, standard format 24 data bit + 7 status bits	
6.	Status bits:	"0"; all status bit functions disabled
7.	External inputs:	disabled
8.	Limit positions	"0"
9.	Overspeed:	"0"

5.3 Initial operation

No special procedures are required for taking the device into operation. Power supply, clock and data lines must be laid and connected to the control system as specified in the connection plan in the chapter "Technical data" on page 28. The easiest way for programming the encoder is to use a PC (order programming software with adapter cable under item no. 1543014).

For programming via programming unit the signals RxD, TxD and signal ground must be connected.

6 Technical data

Mechanical:

Shaft diameter	6 mm (synchro-flange), 10 mm (clamping flange)
Shaft load	6-mm shaft: axial 60 N (13 lbs), radial 110 N (24 lbs) 10-mm shaft: axial 107 N (24 lbs), radial 160 N (35 lbs)
Maximum speed	10000 min^{-1} (short-time basis), 6000 min^{-1} (continuous duty)
Torque	≤ 0.5 Ncm
Moment of inertia	Synchro-flange: 14 gcm^2; clamping flange: 20 gcm^2
Protection class (EN 60529) [1]	Housing IP 65, Bearing IP 64 [2]
Operating temperature	-10 ... +60 °C
Storage temperature	-25 ... +85 °C
Vibration performance (IEC 68-2-6)	100 m/s^2 (10 - 500 Hz)
Shock resistance (IEC 68-2-27)	1000 m/s^2 (6 ms)
Connections	Cable, connector, connector+preset button
Housing	Aluminium
Flange	S= synchro-flange, K= clamping flange
Weight	Multi turn 350 g approx., single turn 300 g approx.
Bearing life	1 x 10^{10} revolutions (typ.) at 35% of full rated shaft load 1 x 10^9 revolutions (typ.) at 75% of full rated shaft load 1 x 10^8 revolutions (typ.) at 100% of full rated shaft load

[1] IP 67 on request
[2] no standing water allowed at the shaft entrance or the ball bearing

Electrical:

General design	according to EN 61010-part 1, protection class III, contamination level 2, overvoltage category II
Supply voltage	10 ... 30 V DC (SELV)
Induced current absorption; recommended external fuse	max. 0,2 A; T 0,25 A
EMC [1]	Interference emissions according to EN 50081-2 Interference immunity according to EN 50082-2
Interfaces RS 485 for SSI data output RS 232c for programming	SSI baud rate 70 ... 1500 Kbit/s Function: Transmission of encoder parameters to RA58-P. Reading of stored encoder parameters and encoder actual values from RA58-P. Baud rate (fixed): 2400 Baud. Byte format: 1 start bit, 8 data bits, no parity, 1 stop bit. Protocol: DK3964R (Siemens) Protocol length: 4 Byte to RA58-P 4 Byte from RA58-P (without protocol frame) Signals: RxD, TxD, signal ground
Physical resolution [2]	4096 increments/4096 revolutions (24 Bit) multiturn
Linearity	± ½ LSB
Type of code	Binary or Gray (programmable)
Data update	every 600 µs
Programmable functions	Code sequence (Direction), scaling factor, preset, offset, output format, output code
External control inputs	Direction, ext. Preset 1 (for version RS485+preset button Preset 1 can be activated by the button), ext. Preset 2; Inputs are only enabled when programmed to „ On“. Function is activated by 1-level (1-level= U≥10 VDC, 0-level=U≤2VDC or open). Pulse time for ext. presets >255 ms (internal fixed debouncing time)
Max. cable length	400 m for SSI (refer to „ Recommended data transmission rate for SSI“) 20 m for programming via RS 232 (RxD and TxD)

[1] when observing the instructions for screening (see Chapter 1)

[2] actual resolution of the encoder disk; in addition, the desired resolution can be minimised by programming the encoder.

Recommended data transmission rate for SSI:

The maximum data transmission rate depends on the length of cable.
For Clock/$\overline{\text{Clock}}$ and Data/$\overline{\text{Data}}$ respectively use twisted wire pairs.
Use a screended cable.

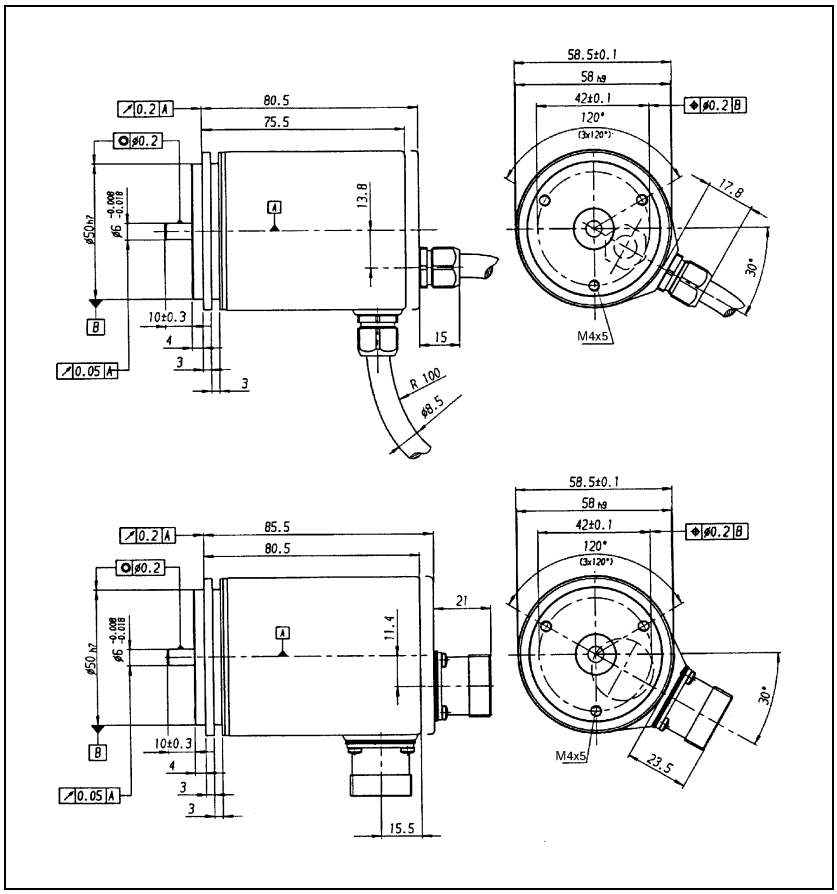
Cable length	Baud rate
< 50 m	< 400 kHz
< 100 m	< 300 kHz
< 200 m	< 200 kHz
< 400 m	< 100 kHz

Pin assignment

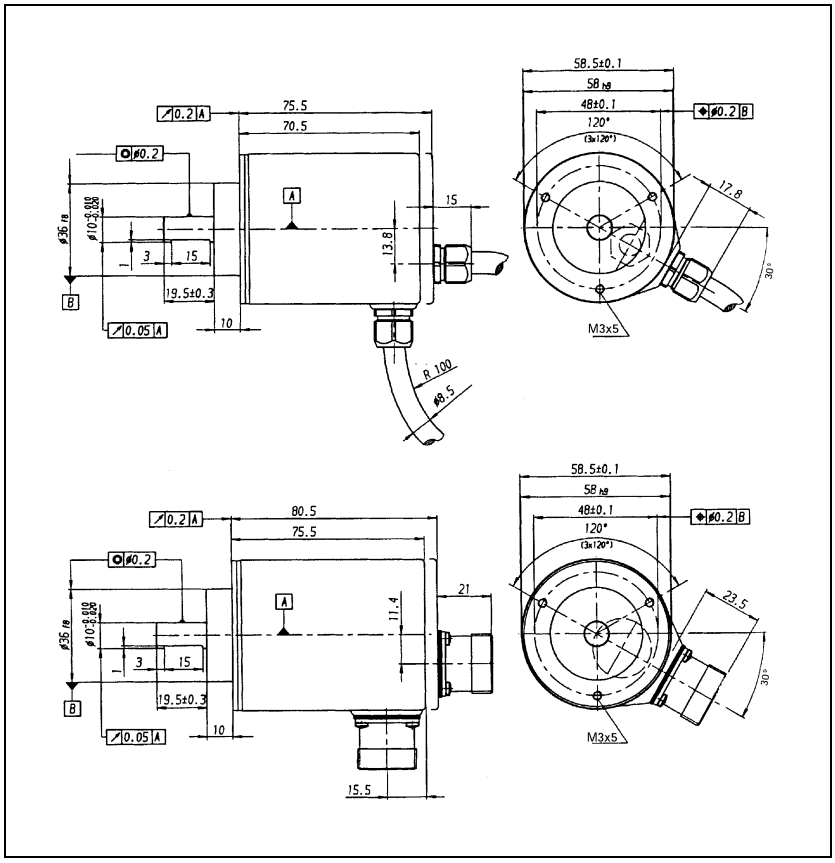
Electrical connection Signal	Flange socket CONIN, 12-pole, ccw. Pin no.	Cable Colour
$\overline{\text{Clock}}$	1	green
Clock	2	yellow
$\overline{\text{Data}}$	3	pink
Data	4	gray
RS 232 TxD	5	brown
RS 232 RxD	6	white
0 V signal output	7	black
$\overline{\text{Direction}}$	8	blue
Preset1	9	red
Preset2	10	violet
10...30 VDC	11	white, 0.5mm^2
0 V (supply voltage)	12	brown, 0.5mm^2

7 Dimensioned drawings

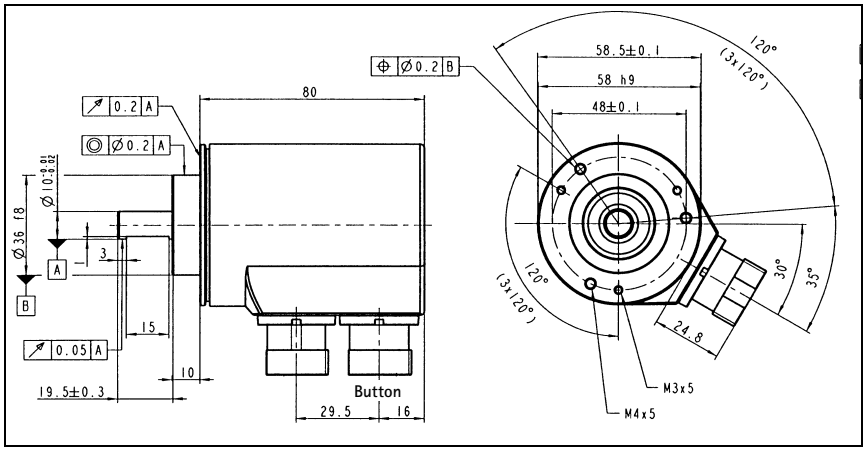
Synchro flange



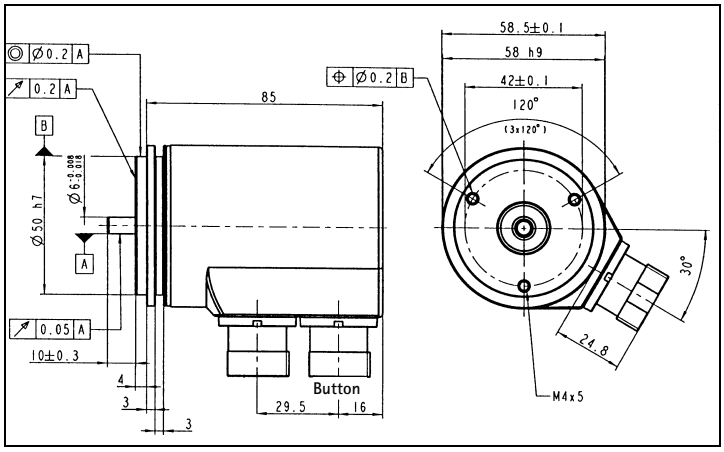
Clamping flange



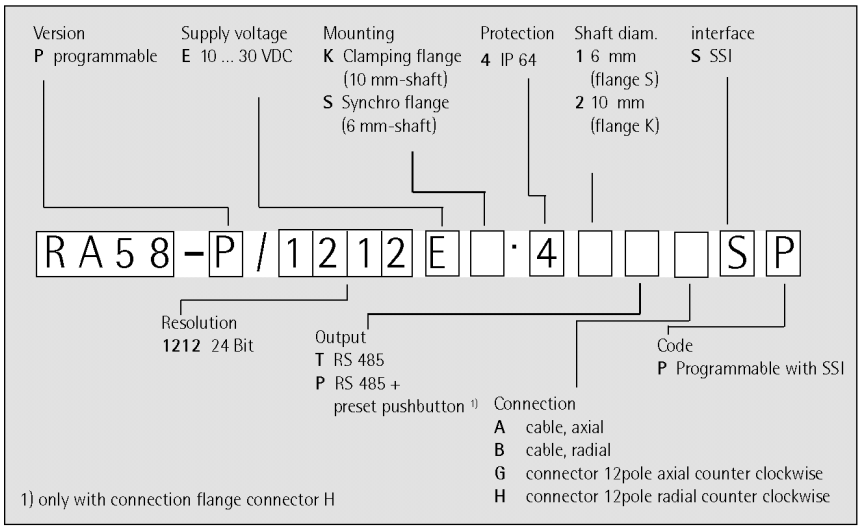
Clamping flange with connector + preset button:



Synchro flange with connector + preset button:



8 Ordering Data



Accessories:

Programming software for DOS (including adapter cable), German	Ord. code 1 543 001
Programming software for DOS (including adapter cable), English	Ord. code 1 543 014
User manual RA 58-P with SSI, German	Ord. code 2 543 002
User manual RA 58-P with SSI, English	Ord. code 2 543 005
User manual PC programming software for SSI, German	Ord. code 2 543 004
User manual PC programming software for SSI, English	Ord. code 2 543 006

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